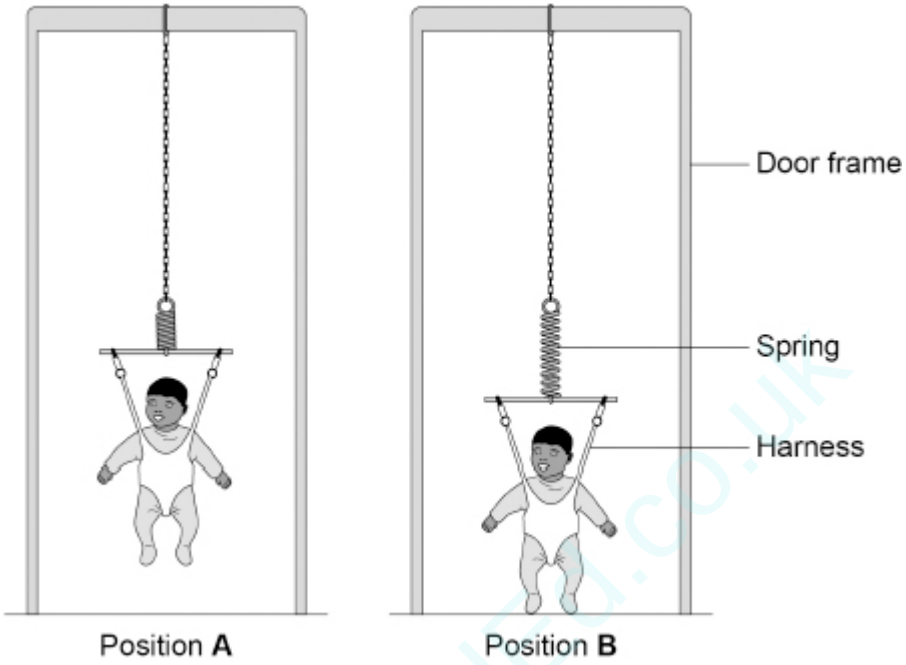
Q1.

A baby bouncer is a harness attached to a spring that hangs from a door frame.

The figure above shows a baby in a baby bouncer in two positions.



(a) The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

_____

_____

_____

(1)

(b) In positions **A** and **B** the baby is stationary.

Describe the energy transfers as the baby moves from position **A** to position **B**.

_____

_____

_____

_____

_____

_____

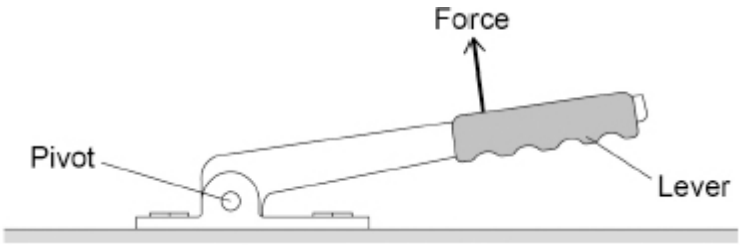
(3)

Q2.

Some cars have a lever that is used to apply the handbrake.

Figure 1 shows the handbrake lever in a car.

Figure 1



(e) Explain why the temperature of the brakes increases as they are used.

_____

_____

_____

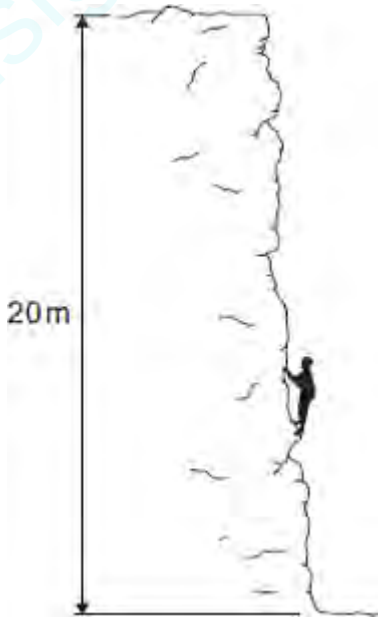
_____

_____

(2)

Q3.

The diagram shows a climber part way up a cliff.



(a) Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational _____ energy.

(1)

(b) The climber weighs 660 N.

(i) Calculate the work the climber must do against gravity, to climb to the top of the cliff.

_____

_____

Work done = _____ J

(2)

Q4.

The diagram below shows a cyclist riding along a flat road.

(a) Complete the sentence.

Choose answers from the box.

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

(2)

(d) How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

Decreased ☐

Increased ☐

Not affected ☐

(1)

(Total 7 marks)

Q5.

Figure 1 shows a cyclist riding along a straight, level road at a constant speed.

Figure 1

(a) Complete the sentences.

As the cyclist rides along the road, the _____ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is _____ the work done against air resistance.

(2)

(c) Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

_____

_____

_____

_____

Work done = _____ J

(3)

(e) The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

_____

_____

_____

_____

_____

_____

(3)

Q6.

The image shows a battery-powered drone.

(a) Complete the sentences.

Choose the answers from the box.

	chemical	**elastic potential**
gravitational potential	**kinetic**	**nuclear**

As the drone accelerates upwards

its _____ energy increases

and its _____ energy increases.

The _____ energy store

of the battery decreases.

(3)

(b) In the USA, drones are not allowed to be flown too high above the ground.

Suggest **one** possible risk of flying a drone too high above the ground.

_____

_____

_____

(2)

Q7.

(a) During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

_____

_____

_____

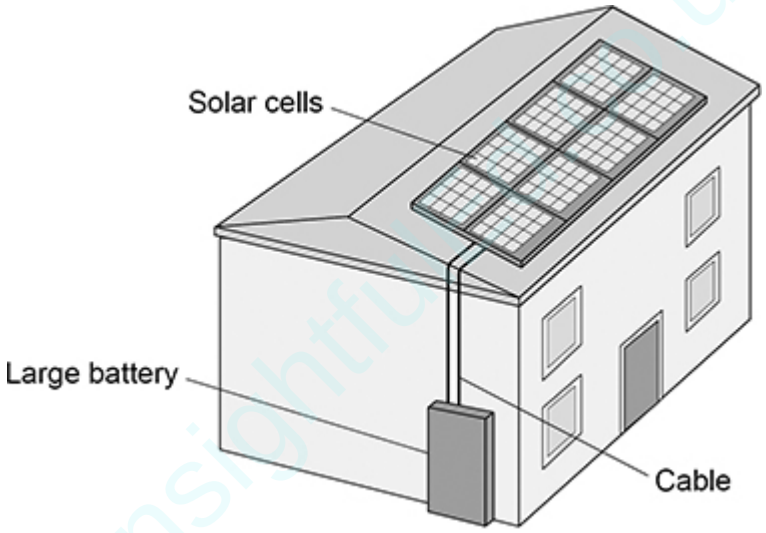
Energy each second (3 significant figures) = _____ J

(2)

The figure below shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.



(d) It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

_____

_____

_____

_____

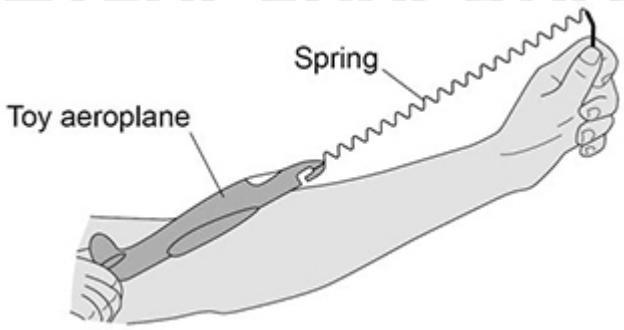
(2)

(Total 11 marks)

Q8.

The figure below shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.



(b) Complete the sentence.

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

(1)

(c) Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

_____

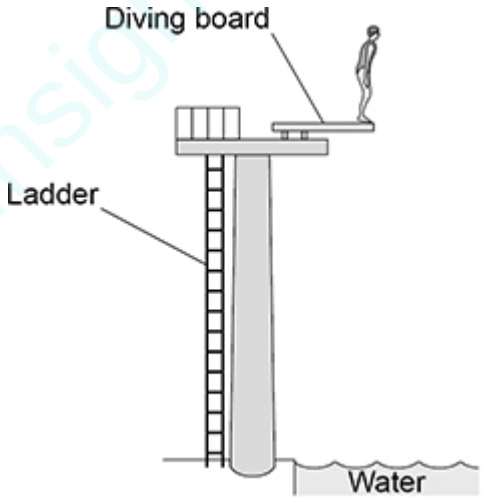
_____

(1)

(Total 8 marks)

Q9.

The figure below shows a diver about to dive off a diving board.



(a) Complete the sentences.

Choose answers from the box.

elastic potential	**gravitational potential**	**kinetic**	**nuclear**

As the diver falls towards the water there is a decrease in

her _____ energy.

As the diver falls towards the water there is an increase in

her _____ energy.

(2)

(d) Most of the kinetic energy of the diver is transferred to the water.

How does this affect the thermal energy of the water?

Tick (✓) **one** box.

The thermal energy decreases.	☐
The thermal energy stays the same.	☐
The thermal energy increases.	☐

(1)

(Total 7 marks)

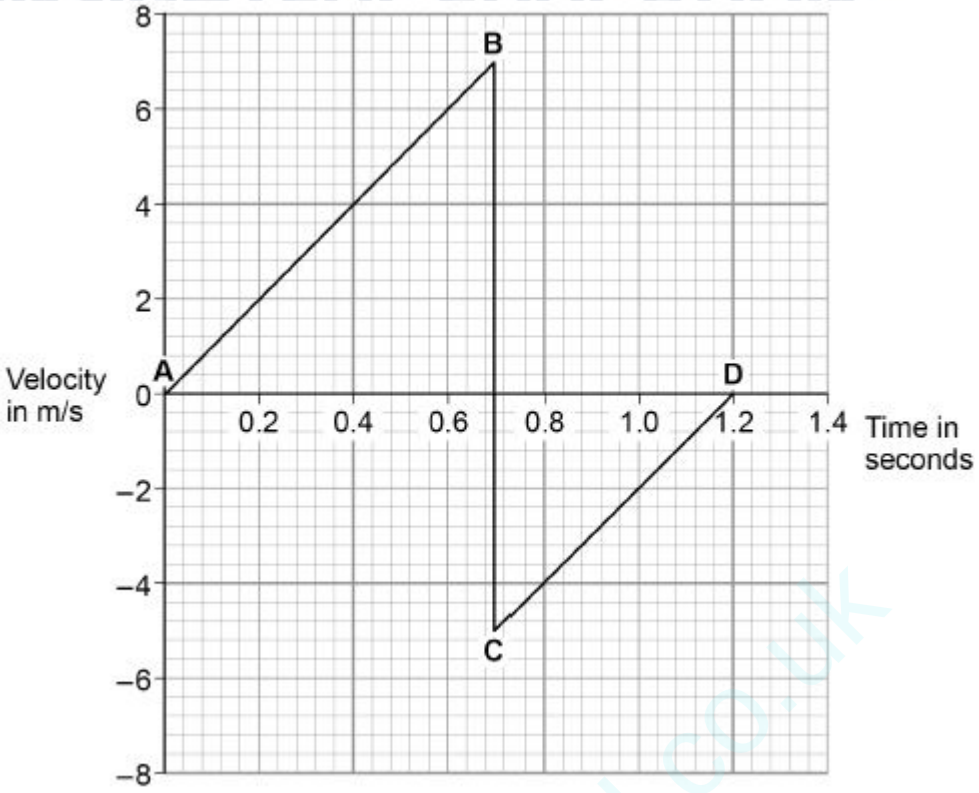
Q10.

A child drops a ball.

The ball hits the ground and bounces.

The graph below shows the velocity-time graph for the ball from when the ball is dropped until when the ball reaches the top of its first bounce.

Air resistance has been ignored.



(a) Describe the motion of the ball between points **A** and **B** on the graph above.

_____

_____

_____

_____

(2)

(b) What direction is the ball moving between points **C** and **D** on the graph above?

_____

(1)

(c) The ball and the Earth form a system.

What is meant by 'a system'?

Tick **one** box.

A group of objects that interact. ☐

Objects with big differences in mass. ☐

Objects with gravitational potential energy. ☐

(1)

(d) When the ball hits the ground, energy is transferred from the ball to the Earth.

Explain how the data in the graph above shows this energy transfer.

(4)

(Total 8 marks)

Q1.

(a) spring may become permanently extended

ignore reference to limit of proportionality

allow the harness / spring / chain may break

or

extension of the spring may be too great (so the baby's feet are always on the floor)

ignore baby may be injured / harmed / may hit doorframe

1

(b) (in position **A**) the baby has gravitational potential energy

allow E_p for gravitational potential energy

1

(as the baby moves down this) is transferred to kinetic energy

allow E_k for kinetic energy

(of the baby) and / then elastic potential energy (of the spring)

allow E_e for elastic potential energy

1

(in position **B**) all the energy is elastic potential energy

ignore energy dissipated to the surroundings

1

Q2.

(e) work is done due to friction (in the brakes)

ignore friction alone

1

(causing) an increase in the internal / thermal energy (of the brakes)

1

Q3.

(a) potential

1

(b) (i) 13 200

*allow **1** mark for correct substitution, ie 660 × 20 provided no subsequent step shown*

2

Q4.

(a) chemical

kinetic **1**

in this order only **1**

(d) increased **1**

[7]

Q5.

(a) chemical **1**

equal to

allow the same as **1**

in this order only

(c) $200 = \frac{W}{1800}$ **1**

W = 200 × 1800 **1**

W = 360 000 (J) **1**

*an answer of 360 000 (J) scores **3** marks*

(e) maximum speed is lower **1**

because maximum power output of cyclist is constant

allow maximum force on pedals is constant **1**

(but) additional work is done (against gravity)

*do **not** accept additional work done against friction or air resistance*

or

gravitational potential energy (of cyclist) is increased **1**

[11]

Q6.

(a) gravitational potential **1**

kinetic **1**

chemical **1**

(b) flying drones may damage aircraft
or
falling drones may injure people
or
damage buildings / vehicles

allow any sensible suggestion of a hazard caused by a flying / falling drone

1

Q7.

(a) $E = \frac{1.25 \times 10^{18}}{3.16 \times 10^{7}}$

1

$E = 3.96 \times 10^{10}$ (J)

*an answer that rounds to 3.96 × 10¹⁰ (J) scores **1** mark*

1

(d) a really large area of land would need to be covered with solar cells

1

due to the low useful power output of the solar cells

allow due to the low efficiency of the solar cells

or

number of hours of daylight is too low (in UK)

or

low solar intensity (in UK)

or

solar radiation (in UK) is too low

or

material for construction of solar cells and/or lithium batteries is in limited supply

1

[11]

Q8.

(b) kinetic

1

(c) increasing the extension of the spring
or
more elastic potential energy
or
increase the angle of release (to the horizontal by a small amount)

allow other factors that would increase the horizontal distance travelled eg a tail-wind

ignore factors without a change specified e.g. extension unqualified would not score

ignore changing the spring or changes to the toy aeroplane

1

[8]

Q9.

(a) gravitational potential

this order only

1

kinetic

1

(d) the thermal energy increases.

1

[7]

Q10.

(a) uniform acceleration

allow constant / steady acceleration
allow velocity / speed increasing at a constant rate
ignore reference to direction
*acceleration scores **1** mark*
or
*velocity / speed is increasing scores **1** mark*
*do **not** accept acceleration increases*

2

(b) up(wards)

1

(c) a group of objects that interact

1

(d) velocity just after bounce is less than just before bounce

allow velocity is less / decreases
velocity decreases to zero − on its own scores zero

or

the height at the top of the bounce is less than the height from which it was dropped

1

so the ball has lost energy

1

correct reference to (loss of) ke or (reduced) gpe

1

total energy of ball and Earth / ground is constant

allow 'a system' for ball and Earth
allow energy is conserved

1

[8]